Superconducting ground state for a doped Mott insulator

Zheng-Yu Weng

Institute for Advanced Study, Tsinghua University

In this talk, I will present a d-wave superconducting ground state [1]. for a doped Mott insulator, which is distinguished from a Gutzwiller-projected BCS superconductor by an explicit separation of Cooper pairing and resonating valence bond (RVB) pairing. Such a state satisfies the precise sign structure of the t-J model [2], just like that a BCS state satisfies the Fermi-Dirac statistics. I will show that this new class of wavefunctions can be understood by intrinsic electron fractionalization with neutral spinons and backflow spinons forming a two-component RVB structure. While the former spinon is bosonic, originated from the superexchange correlation, the latter spinon is found to be fermionic, accompanying the hopping of bosonic holons. The low-lying emergent gauge fields associated with such a specific fractionalization are of mutual Chern-Simons type [3]. Corresponding to this superconducting ground state, three types of elementary excitations are identified. Among them a Bogoliubov nodal quasiparticle is conventional, while the other two are neutral excitations of non-BCS type that play crucial roles in higher energy/temperature regimes. Their unique experimental implications for the cuprates will be also discussed.

[1]Z. Y. Weng, arXiv:1105.3027.
[2]K. Wu, Z. Y. Weng, and J. Zaanen, Phys. Rev. B 77, 155102 (2008).
[3]P. Ye, C. S. Tian, X. L. Qi, and Z. Y. Weng, Phys. Rev. Lett. 106, 147002 (2011).

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